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A new Approach to SPACE Matrix

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Abstract. One of the important tools in strategic planning is Strategic Position and Action Evaluation (SPACE) Matrix. SPACE matrix introduces a methodology for selecting a suitable strategy for an organization. This strategy can be aggressive, defensive, Conservative, or Competitive. Common tools in strategic planning such as SPACE matrix have some limitations. Selecting the strategy based on binary logic is one of their significant limitations. In conventional dual logic, we have to place issues in two categories. For instance, in strategic planning, a strategic action is either aggressive or no aggressive – and nothing in between.Using the crisp values (number) for analyzing the expert's viewpoints is another limitation to determine a strategy based on this matrix.In this paper, we try to introduce a method to remove these limitations. This method has been developed base on the fuzzy logic concepts.

Keywords: strategic planning, SPACE matrix, fuzzy set theory

1. Introduction

Senior managers perceive the strategy development process as involving a high degree of uncertainty and ambiguity (Li et al., 2000). It is evident that one principal factor leading to managerial dissatisfaction is the systems' inability to deal with uncertainty (Li et al., 2000). Brownlie and Spender (1995) argue that uncertainty and ambiguity are important issues in strategic marketing decisions. Levin et al. (1995) argue that marketing decisions are subject to multiple sources of uncertainties and contain fuzzy issues. Levy and Yoon (1995) point out that fuzziness, imprecise measures and uncertainty about strategic factors all affect marketing decision making. Mintzberg (1994a, b, c) argues that because managers have experience, intuition and judgement about their products, customers and markets, strategic planning must be coupled with managers' intuition and judgement to ensure the best of human thinking. According to the mail survey findings by Li et al. (2000), many managers reported that their intuition and judgement are important in strategy development. Hence, managerial judgement and intuition should be an integral part of the strategy development process (Li et al., 1999).Most of our traditional tools for formal modeling, reasoning, and computing are crisp, deterministic, and precise in character (Zimmermann, 1996, 1). There is a paradox between these subjects and tools. Conventional tools that are applied in strategic planning such as SPACE matrix like many other tools in management literature are applied according to concepts of binary logic. In conventional dual logic we have to place issues in two categories. For instance, In strategic planning, a strategic action is either aggressive or no aggressive – and nothing in between. If we suppose the strategic positions are as sets, according to set theory, the position of an organization only can be belonged to one set. There are no ambiguities in this logic. The boundary of each set (strategic position) is certain and obvious. In spite of the concepts of dual logic, process of strategy selection is full of ambiguity because an organization's strategy is developed based on experts' viewpoint. These viewpoints have formed according to experts' skills, experience, educations, etc. In generally speaking, in models, which we have to use experts' viewpoints, the

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ambiguity and darkness concepts are entered in our models but Our models for developing an organization's strategy such as SPACE matrix, BCG matrix, IE matrix are precise and certain but data needed for these models are full of ambiguity and vagueness. That way, a suitable tool is required for modeling in these conditions. It seems that the fuzzy set theory introduces appropriate tools for modeling concepts of ambiguity. Fuzzy logic is a technique which is designed to cope with imprecise linguistic concepts or fuzzy terms (Zadeh, 1988). Fuzzy logic allows users to provide inputs in imprecise terms and receive either fuzzy or precise advice. The technique can also be applied to model imprecise modes of reasoning (Zadeh, 1988; Goonatilake and Khebbal, 1995).In this paper, we apply Fuzzy Set concepts for reintroducing SPACE matrix. The approach that is introduced in this paper can use for analyzing other strategic planning tools such as BCG, GE, IE matrix.

2. Strategic Position and Action Evaluation (SPACE) Matrix

Strategic Position and Action Evaluation (SPACE) Matrix has been materialized as a dominant instrument in formulating alternative strategies. This matrix is also based on four important elements called four quadrants of SPACE Matrix. First two elements called internal dimensions which are Financial Strength (FS) and Competitive Advantage (CA) and other two are called external dimensions namely Environmental Stability (ES) and Industry Strength (IS). Undoubtedly these four rudiments are conceivably the most imperative determinants of an organization’s by and large strategic position. The four quadrants framework of SPACE Matrix represents the suitability or appropriateness of the strategies to be selected by a company such as aggressive, conservative, defensive, or competitive strategies.Fig. 1 illustratesthe SPACE matrix.

To apply this matrix it is need to measure external and internal dimensions for an organization.In classic form amount of IS and FS isa number from 1 to 6 andthat of CA and ES is a number from -1 to -6.Number +6 and -1explain the best conditions and number +1 and -6 explain worst status. After adding up the number of IS tothat of CA and adding up the magnitude ofFS to that of ES,ordered couple i.e. ((IS+CA),(FS+ES)) is yield.WeJoin the origin of Cartesian coordinates to this ordered couplean arrow is funded.Position ofthis arrow identifies the type of strategy.

According to this methodology, the strategy of an organization can be one of four type strategies. In other words, we cannot select more than one strategy for an organization. According to current methodology, all points (ordered couples) in each quadrant have same value. This is a presumption in this methodology.Nevertheless, these points have different values.

If we apply this methodology we will not be able to advice suitable strategy for an organizationwhen situations (ordered couple) of an organization is on axis (for example E) or in center of matrix (for example F).

Applying binary logic for developing the SPACE matrix has created these problems. It seems that the concept of dual logic is not suitable for studying issues such as strategy.Therefore, in this paper, a new approach is introduced based on fuzzy logic to overcome these limitations.According to recent logic, an organization can be having more than one type strategy. Even its strategies can be a set of four types of strategies.

3. New approach to SPACE matrix

In this section, we introduce the fuzzy method for developing SPACE matrix. To do so, the following stages are proposed:

First stage: listthe most important attributes of financial strength (FS), competitive advantage(CA), environmental stability(ES), and industry strengths(IS). Table 1 illustrates a sample of these attributes.

Table 1: A sample of attributes

Attributes of Financial Strength (FS)		Attributes of Competitive Advantage (CA)	
• Return of investment • Financial and operating leverage • Liquidity	• Working capital • Cash flows	Market share • Quality • Product life cycle • Customer preference	• Technological innovation • Sound supply chain

Attributes of Environmental Stability (ES)		**Attributes of Industry Strength (IS)**	
• Technological changes Inflation • Demand elasticity • Competitor's price ranges • Barriers to entry	• Competitive pressure • Ease of exit • Price elasticity of demand • Risk exposure	• Growth potential • Profit potential •Financial stability	• Resource availability • Ease of entry • Capacity utilization

Second stage: assigningweights for allattributes of each variables

Some methods can be used to obtain these weights. Here pair wise comparisons matrix are offered. The scale assumes that the ROW (first) criterion being ranked is of equal or greater importance than the COLUMN (second) criterion. Fuzzy triangular numbers are proposed for comparison. If you have a pairing where the row criterion is less important than the column, use the reciprocal value.

Table 2 illustrates pairwise comparisons based on importance of variables in specific business for each one of four important elements (FS, CA, ES, IS)

Table1 : pairwise comparison matrix

Importance in industrial	F_1^F	F_2^F	F_3^F	F_4^F
F_1^F	(1 1 1)	(L_{12}, M_{12}, U_{12})	(L_{13}, M_{13}, U_{13})	(L_{14}, M_{14}, U_{14})
F_2^F	$(\frac{1}{U_{12}}, \frac{1}{M_{12}}, \frac{1}{L_{12}})$	(1 1 1)	(L_{23}, M_{23}, U_{23})	(L_{24}, M_{24}, U_{24})
F_3^F	$(\frac{1}{U_{13}}, \frac{1}{M_{13}}, \frac{1}{L_{13}})$	$(\frac{1}{U_{23}}, \frac{1}{M_{23}}, \frac{1}{L_{23}})$	(1 1 1)	(L_{34}, M_{34}, U_{34})
F_4^F	$(\frac{1}{U_{14}}, \frac{1}{M_{14}}, \frac{1}{L_{14}})$	$(\frac{1}{U_{24}}, \frac{1}{M_{24}}, \frac{1}{L_{24}})$	$(\frac{1}{U_{34}}, \frac{1}{M_{34}}, \frac{1}{L_{34}})$	(1 1 1)

According to Extended Analysis (EA) S_K s are calculated for each row by following method:

$$s_k = \sum_{j=1}^{n} M_{ijk} \times \left[\sum_{i=1}^{n} \sum_{j=1}^{m} M_{ij} \right]^{-1}$$

Where k refer to number of row and M_{ij} expresses the priority of criteria i to j. S_k s are as fuzzy numbers. If we suppose $S_1 = (l_1 \; m_1 \; u_1)$, $S_2 = (l_2 \; m_2 \; u_2)$, …, $S_k = (l_k \; m_k \; u_k)$,the degree of possibility (V) of $S_1 \geq S_2 \geq ... \geq S_k$ is presented as follows:

$$\begin{cases} V(S_1 \geq S_2) = 1 & \text{if } m_1 \geq m_2 \\ 0 & \text{if } l_2 \geq u_1 \\ V(S_1 \geq S_2) = hgh(S_1 \cap S_2) = \dfrac{l_2 - u_1}{(m_1 - u_1) + (m_2 - l_2)} & \text{otherwise} \end{cases},$$

$$V(S_1 \geq S_2, S_3, ..., S_k) = \min[V(S_1 \geq S_2), V(S_1 \geq S_3, ..., V(S_1 \geq S_k)]$$

Assume that $d'(A_i) = \min(V(S_i \geq S_k)$ for $k = 1,2,3,...,n \quad k \neq i$ .then the weight vector is given $W' = [w'_{(A_1)}, w'_{(A_2)}, ..., w'_{(A_n)}]^T$ .Via normalization, the normalized weight vectors are $W = [w_{(A_1)}, w_{(A_2)}, ..., w_{(A_n)}]^T$ where W is a nonfuzzynumber that gives priority weights of an attribute.

Third stage: Assign a numerical value ranging from worst to best for attributes of each FS, IS, ES, and CA. Table 2 illustrates this scale based on fuzzy triangular numbers.

Table2: scale for measuring FS, IS, ES, and CA

Verbal variable	Fuzzy number for ES and CA(S_i)	Fuzzy number for IS and FS(S_i)
Very bad	(-4 -5 -5)	(1 1 2)
Bad	(-3 -4 -5)	(1 2 3)
Average	(-2 -3 -4)	(2 3 4)
Good	(-1 -2 -3)	(3 4 5)
Very good	(-1 -1 -2)	(4 4 5)

Forth stage: in this step, final value of FS, IS, ES, and CA is calculated by following:

$$ES = \sum W_i^e S_i^e \;,\; IS = \sum W_i^i S_i^i \;,\; FS = \sum W_i^{fs} S_i^{fs} \;,\; CA = \sum W_i^c S_i^c$$

$$0 \le W_i^{ES}, W_i^{IS}, W_i^{FS}, W_i^{CA} \le 1 \quad , \quad \sum W_i^{ES} = \sum W_i^{IS} = \sum W_i^{Fs} = \sum W_i^{CA} = 1 \quad i = 1,2,3,\ldots, n$$

Where W_i s are weights for all attributes of each factor and S_i s are value of them.

Fifth stage: Adding the two values on x-axis (competitive advantage and industry strength) and plotting the resultant value on x-axis.In this way adding the two values on y-axis (financial strength and environmental stability) and plotting the resultant value on y-axis.A directional vector should be drawn from the origin of the SPACE Matrix to ordered couple i.e. ((IS+CA), (FS+ES)) which represents the strategies to be pursued i.e. aggressive, conservative, defensive, or competitive.

Eighth stage: identifying the degree of membership of organization position in each strategic positions

Four strategic positions are considered in form of fuzzy set. These sets are constructed by ordered couples. Degree of membership of any ordered couples in any set identifies the measure of suitableness of any strategy. Thus, we have to determine four degree of membership for an organization's ordered couple.To do so, the points on matrix that are completely representative of each strategic position are identified.According to literature background points $\tilde{A}, \tilde{B}, \tilde{C}, \tilde{D}$ completely represent aggressive, conservative, defensive, and competitiverespectively. Then distance between organization position from each four positions is calculated by following when $\tilde{P}(p_1, p_2)$ is an organization strategic position on SPACE matrix. These distances presents membership degree of $\tilde{P}$ in each four positions.

$$\tilde{D}(\tilde{A}, \tilde{P}) = \sqrt{(a_1 - p_1)^2 + (a_2 - p_2)^2} \quad \tilde{D}(\tilde{B}, \tilde{P}) = \sqrt{(b_1 - p_1)^2 + (b_2 - p_2)^2}$$

$$\tilde{D}(\tilde{C}, \tilde{P}) = \sqrt{(c_1 - p_1)^2 + (c_2 - p_2)^2} \quad \tilde{D}(\tilde{D}, \tilde{P}) = \sqrt{(d_1 - p_1)^2 + (d_2 - p_2)^2}$$

Ordered couples on matrix are in fuzzy form so mathematical operations will be in fuzzy environment too. Distance between two fuzzy numbers is a fuzzy number too. Thus to defuzzyand compare these numbers, the degree of possibilities of every distance is calculated by second stage method.

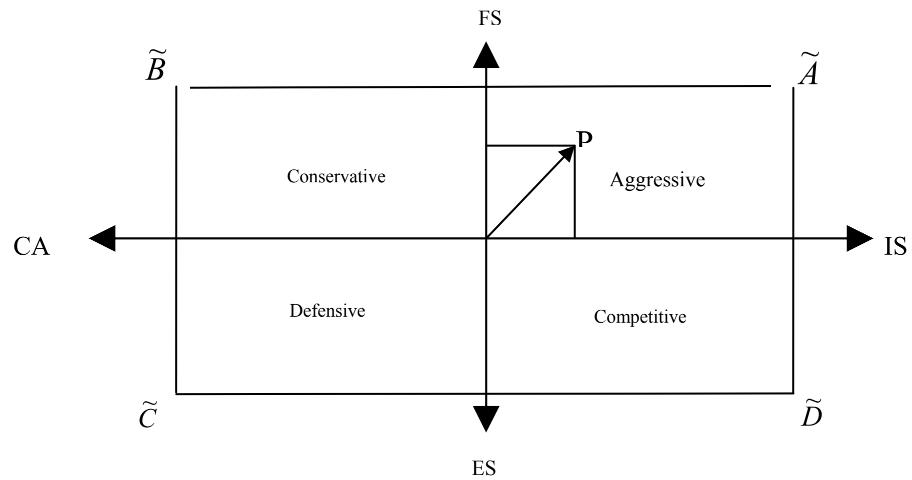

Fig1: SPACE matrix

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